FISHERY RESEARCH

SNAKE RIVER SOCKEYE SALMON CAPTIVE BROODSTOCK PROGRAM HATCHERY ELEMENT

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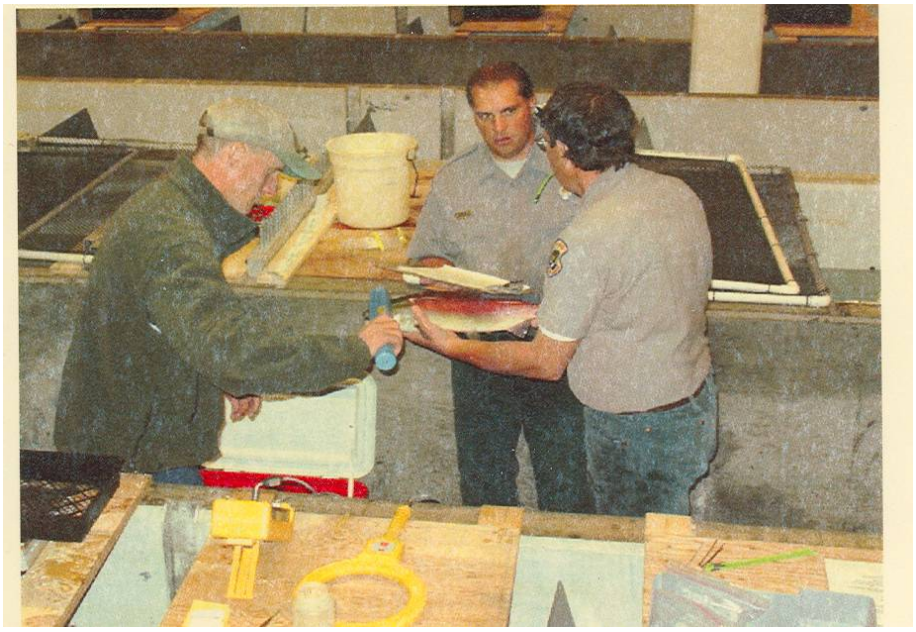

Prepared by:

Dan J. Baker, Hatchery Manager II
Jeff A. Heindel, Assistant Hatchery Manager
Jeremy J. Redding, Fish Culturist
and
Paul A. Kline, Principal Fisheries Research Biologist

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Snake River Sockeye Salmon Captive Broodstock Program Hatchery Element

Project Progress Report

2003 Annual Report

By

Dan J. Baker
Jeff A. Heindel
Jeremy J. Redding
Paul A. Kline

Idaho Department of Fish and Game
600 South Walnut Street
P.O. Box 25
Boise, ID 83707

To

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97283-3621

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EXECUTIVE SUMMARY

On November 20, 1991, the National Marine Fisheries Service listed Snake River sockeye salmon *Oncorhynchus nerka* as endangered under the Endangered Species Act of 1973. In 1991, the Idaho Department of Fish and Game, the Shoshone-Bannock Tribes, and the National Marine Fisheries Service initiated efforts to conserve and rebuild populations in Idaho.

Initial steps to recover sockeye salmon included the establishment of a captive broodstock program at the Idaho Department of Fish and Game Eagle Fish Hatchery. Sockeye salmon broodstock and culture responsibilities are shared with the National Oceanic and Atmospheric Administration at two locations adjacent to Puget Sound in Washington State. Activities conducted by the Shoshone-Bannock Tribes and the National Oceanic and Atmospheric Administration are reported under separate cover. Idaho Department of Fish and Game monitoring and evaluation activities of captive broodstock program fish releases (annual report to the Bonneville Power Administration for the research element of the program) are also reported separately. Captive broodstock program activities conducted between January 1, 2003 and December 31, 2003 for the hatchery element of the program are presented in this report.

In 2003, three anadromous sockeye salmon returned to the Sawtooth Valley. Two of these adults were captured at the adult weir located on Redfish Lake Creek. The third anadromous sockeye salmon, routinely observed below the Sawtooth Fish Hatchery weir, failed to ascend the adult ladder and was allowed to migrate upstream volitionally (following the dismantling of the weir on September 9, 2003). The two adults captured in program weirs were transferred to Eagle Fish Hatchery on September 17, 2003 and were incorporated into the spawning design.

Two anadromous females, 196 captive females from brood year 2000 and 11 captive females from brood year 2001 broodstock groups were spawned at the Eagle Hatchery in 2003. Spawn pairings produced approximately 303,983 eyed-eggs with egg survival to eyed stage of development averaging 88.9%.

Eyed-eggs (199,666), presmolts (76,788), and adults (315) were planted or released into Sawtooth Valley waters in 2003. Reintroduction strategies involved releases to Redfish Lake, Alturas Lake, and Pettit Lake.

During this reporting period, five broodstocks and two unique production groups were in culture at Idaho Department of Fish and Game facilities (Eagle Fish Hatchery and Sawtooth Fish Hatchery). Three of the five broodstocks were incorporated into the 2003 spawning design, and one broodstock was terminated following the completion of spawning.

Authors:

Dan J. Baker
Hatchery Manager II

Jeff A. Heindel
Assistant Hatchery Manager

Jeremy J. Redding
Fish Culturist

Paul A. Kline
Principal Fisheries Research Biologist

INTRODUCTION

Numbers of Snake River sockeye salmon *Oncorhynchus nerka* have declined dramatically in recent years. In Idaho, only the lakes of the upper Salmon River (Sawtooth Valley) remain as potential sources of production (Figure 1). Historically, five Sawtooth Valley lakes (Redfish, Alturas, Pettit, Stanley, and Yellowbelly) supported sockeye salmon (Bjornn et al. 1968; Chapman et al. 1990). Currently, only Redfish Lake receives a remnant anadromous run.

On April 2, 1990, the National Oceanic and Atmospheric Administration (NOAA) received a petition from the Shoshone-Bannock Tribes (SBT) to list Snake River sockeye salmon as endangered under the Endangered Species Act (ESA) of 1973. On November 20, 1991, NOAA declared Snake River sockeye salmon endangered.

In 1991, the SBT, along with the Idaho Department of Fish & Game (IDFG), initiated the Snake River Sockeye Salmon Sawtooth Valley Project (Sawtooth Valley Project) with funding from the Bonneville Power Administration (BPA). The goal of this program is to conserve genetic resources and to rebuild Snake River sockeye salmon populations in Idaho. Coordination of this effort is carried out under the guidance of the Stanley Basin Sockeye Technical Oversight Committee (SBSTOC), a team of biologists representing the agencies involved in the recovery and management of Snake River sockeye salmon. NOAA ESA Permit Nos. 1120, 1124, and 1233 authorize IDFG to conduct scientific research on listed Snake River salmon.

Initial steps to recover the species involved the establishment of captive broodstocks at the Eagle Fish Hatchery in Idaho and at NOAA facilities in Washington State (for a review, see Flagg 1993; Johnson 1993; Flagg and McAuley 1994; Kline 1994; Johnson and Pravecek 1995; Kline and Younk 1995; Flagg et al. 1996; Johnson and Pravecek 1996; Kline and Lamansky 1997; Pravecek and Johnson 1997; Pravecek and Kline 1998; Kline and Heindel 1999; Hebdon et al. 2000; Flagg et al. 2001; Frost et al. 2001; Kline and Willard 2001; Frost et al. 2002; Hebdon et al. 2002; Hebdon et al. 2003; Kline et al. 2003a; Kline et al. 2003b; Willard et al. 2003a; Willard et at. 2003b).

PROGRAM GOALS

The immediate goal of the program is to utilize captive broodstock technology to conserve the population's unique genetics. Long-term goals include increasing the number of individuals in the population to address delisting criteria and to provide sport and treaty harvest opportunity.

Objectives and Tasks

1. Develop captive broodstocks from Redfish Lake sockeye salmon, culture broodstocks and produce progeny for reintroduction.

2. Determine the contribution hatchery-produced sockeye salmon make toward avoiding population extinction and increasing population abundance.

3. Describe *O. nerka* population characteristics for Sawtooth Valley lakes in relation to carrying capacity and broodstock program reintroduction efforts.

4. Utilize genetic analysis to discern the origin of wild and broodstock sockeye salmon to provide maximum effectiveness in their utilization within the broodstock program.

5. Transfer technology through participation in the technical oversight committee process, provide written activity reports and participate in essential program management and planning activities.

Idaho Department of Fish and Game's participation in the Snake River Sockeye Salmon Captive Broodstock Program includes two areas of effort: 1) sockeye salmon captive broodstock culture, and 2) sockeye salmon research and evaluations. Although objectives and tasks from both components overlap and contribute to achieving the same goals, work directly related to sockeye salmon captive broodstock research appears under a separate cover (Willard et al. 2004). Research and enhancement activities associated with Snake River sockeye salmon are permitted under the ESA (NOAA) Nos. 1120, 1124, and 1233. This report details fish culture information collected between January 1 and December 31, 2003.

METHODS

Fish Culture Facilities

Eagle Fish Hatchery

Eagle Fish Hatchery is the primary Idaho site for the sockeye salmon captive broodstock program. Artesian water from three wells is currently in use. The water system was modified in 2002; three of the five wells were shut down and capped. A new well was developed and was brought online in April 2003. Artesian flow is augmented with three separate pump/motor systems. Water temperature remains a constant 13.5°C, and total dissolved gas averages 100% after degassing. Water chilling capability was added at Eagle Fish Hatchery in 1994. Chiller capacity accommodates incubation, a portion of fry rearing, and a portion of adult holding needs. Backup and system redundancy is in place for degassing, pumping, and power generation. Ten water level alarms are in use, linked through an emergency service contractor. A Hatchery Manager position and residence was added in 2002. Three additional on-site residences occupied by IDFG hatchery personnel provide additional security by limiting public access.

Facility layout at Eagle Fish Hatchery remains flexible to accommodate culture activities ranging from spawning and incubation through adult rearing. Egg incubation capacity at Eagle Fish Hatchery is approximately 300,000 eggs. Incubation is accomplished in small containers specifically designed for the program (Heindel et al., in press) allowing for separation of individual subfamilies. Incubators are designed to distribute both upwelling and downwelling flow to accommodate pre- and post-hatch life stages.

Several fiberglass tank sizes are used to culture sockeye from fry to the adult stage, including 1) 0.7 m diameter semisquare tanks (0.09 m^3); 2) 1.0 m diameter semisquare tanks (0.30 m^3); 3) 2.0 m diameter semisquare tanks (1.42 m^3); 4) 3.0 m diameter circular tanks (6.50 m^3); and 5) 4.0 m diameter semisquare tanks (8.89 m^3). Typically, 0.7 m and 1.0 m tanks

are used for rearing fry from ponding to approximately 1.0 g weight. Two- and three-meter tanks are used to rear juveniles to approximately 10.0 g and to depot and group fish by lineage or release strategy prior to distribution to Sawtooth Valley waters. Three- and four-meter tanks are used to rear fish to maturity for future broodstock production (spawning). Flows to all tanks are maintained at no less than 1.5 exchanges per hour. Shade covering (70%) and jump screens are used where appropriate. Discharge standpipes are external on all tanks and assembled in two sections ("half-pipe" principle) to prevent tank dewatering during tank cleaning.

Sawtooth Fish Hatchery

Sawtooth Fish Hatchery was completed in 1985 as part of the U.S. Fish and Wildlife Service Lower Snake River Compensation Plan and is located on the Salmon River, 3.5 km upstream from the confluence of Redfish Lake Creek. Sawtooth Fish Hatchery personnel and facilities have been utilized continuously since 1991 for various aspects of the sockeye captive broodstock program, including 1) prespawn anadromous adult holding, 2) egg incubation, and 3) juvenile rearing for presmolt and smolt releases. In addition, hatchery personnel assist with many field activities, including 1) net pen fish rearing, 2) fish trapping and handling, and 3) fish transportation and release.

Eyed-eggs, received at Sawtooth Fish Hatchery from Eagle Fish Hatchery or NOAA, are incubated in vertical trays. Fry are ponded to 0.7 m fiberglass tanks. Juvenile sockeye (>1 g) are held in vats or in a series of 2.0 m fiberglass tanks installed in 1997. Typically, juvenile sockeye salmon reared at Sawtooth Fish Hatchery are released as presmolts or smolts. Prespawn anadromous adults captured at Redfish Lake Creek or Sawtooth Fish Hatchery weirs are held in vats until release for natural spawning or transfer to the Eagle Fish Hatchery for artificial spawning. Generally, well water supplies water flow for incubation, rearing, and holding. Well water temperature varies by time of year from approximately 4.0°C minimum in March and April to 10.0°C maximum in September and October. When sockeye salmon are held for smolt releases, they may be moved to outside raceways that receive water from the Salmon River. Salmon River water temperature varies by time of year from approximately 2.0°C in January and February to 14.0°C in August and September. Backup and redundancy water systems are in place. Rearing protocols are established cooperatively between IDFG personnel and reviewed at the SBSTOC level.

Fish Culture

Fish culture methods used in the captive broodstock program follow accepted standard practices (for an overview of standard methods, see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; McDaniel et al. 1994; Bromage and Roberts 1995; Pennell and Barton 1996). Considerable coordination takes place between NOAA and IDFG culture experts and at the SBSTOC level.

Fish are fed a commercial diet produced by Bio-Oregon, Inc. (Warrenton, Oregon). Through approximately 150.0 g weight, fish receive a standard Bio-Oregon semimoist formulation. Rations are weighed daily and follow suggested feeding rates provided by the manufacturer. Bio-Oregon developed a custom broodstock diet that includes elevated levels of vitamins, minerals, and pigments. Palatability and levels of natural pigments are enhanced by the addition of natural flavors from fish and krill. Beyond 150.0 g weight, fish receive the Bio-Oregon custom broodstock diet.

Fish sample counts are conducted as needed to ensure that actual growth tracks with projected growth. In general, fish are handled as little as possible. Age-1 and age-2 sockeye salmon rearing densities are maintained at levels not to exceed 8.0 kg/m^3. Age-3 and age-4 rearing densities are maintained at levels not to exceed 14.0 kg/m^3.

Incubation and rearing water temperature is maintained between 7.0°C and 13.5°C. Chilled water (7.0°C to 10.0°C) may be used during incubation and early rearing to equalize development and growth differences that may result from a protracted spawning period. Rearing water temperature varies as a function of demand, but is generally maintained between 10.0°C and 12:0°C throughout much of the age-2, age-3, and age-4 culture history.

Passive integrated transponder (PIT) tags are used to evaluate the overwinter survival and out-migration success of production groups released to Sawtooth Valley waters. These PIT tags are also used to track sockeye salmon retained in the program as broodstock fish. Production and broodstock sockeye salmon are PIT tagged at approximately six months of age. The PIT tag procedures follow accepted, regional protocols (Prentice et al. 1990).

Chemical therapeutants are used prophylactically and for the treatment of infectious diseases. Before initiating treatments, the use of chemical therapeutants is discussed with an IDFG fish health professional. Fish necropsies are performed on all program mortalities that satisfy minimum size criteria for the various diagnostic or inspection procedures performed. Carcasses are either incinerated, land filled, or rendered.

Anadromous and Residual Adult Sockeye Salmon Trapping

Two adult traps are used to capture returning anadromous sockeye salmon in the Sawtooth Valley. The first trap is located on Redfish Lake Creek approximately 1.4 km downstream from the lake outlet. The second trap is located on the upper Salmon River at the Sawtooth Fish Hatchery weir.

A floating Merwin trap is used to capture residual sockeye salmon adults in Redfish Lake when they are incorporated into the captive broodstock program. When used, the trap is installed in October on the west side of the lake at the north end of Sockeye Beach.

Spawning Activities

Spawning has occurred at Eagle Fish Hatchery each year since 1994 (Johnson and Pravecek 1995; Johnson and Pravecek 1996; Pravecek and Johnson 1997; Pravecek and Kline 1998; Kline and Heindel 1999; Kline and Willard 2001; Kline et al. 2003a; Kline et al. 2003b; Willard et at. 2003a). Before 1994, adult sockeye returns were spawned at the Sawtooth Fish Hatchery (Johnson 1993). Spawning follows accepted standard practices as described by Erdahl (1994) and McDaniel et at. (1994). The IDFG is required by NOAA Permit No. 1120 to discuss proposed broodstock spawning matrices before conducting activities. In general, spawning designs are developed to minimize the loss of genetic diversity in resultant progeny and to minimize inbreeding. Eggs from individual females produced at spawning are typically divided into three lots and fertilized with sperm from three different males (factorial design). Male contribution is subsequently equalized as each male is used to fertilize eggs from three different females (on average). Eggs are incubated on water temperatures determined to meet

program goals for reintroduction via different release strategies and to produce fish to meet future broodstock needs.

Historically, the broodstock program used pedigree information to pool eyed-eggs developed from hatchery spawning into broodstock rearing groups. Identification of familial groups was maintained by tank segregation until they were large enough to PIT tag. Beginning with the 2003 spawn year, genetic identification of BY02 and BY03 broodstocks was determined using microsatellite DNA techniques. In spawn year 2004, breeding plans will rely primarily on genetic information instead of pedigree information. Kinship coefficients and mean kinship coefficients will be used to determine relative founder contribution in the population, genetic importance, and relative relatedness. Breeding plans will also consider heterozygosity and genetic diversity among and within individuals. Genetic-based spawning plans will provide a higher level of resolution in avoiding inbreeding than was possible when pedigree information was used to develop spawning plans.

Milt Cryopreservation

Cryopreservation of milt from male donors has been conducted in the captive broodstock program since 1991 and follows techniques described by Cloud et al. (1990) and Wheeler and Thorgaard (1991). Beginning in 1996, cryopreserved milt was used to produce lineage-specific broodstocks for use in future spawn years. "Designer broodstocks" produced in this manner will increase the genetic variability available in future brood years.

Fish Health Investigations

The captive broodstock rearing program utilizes disinfectants, antibiotics, vaccinations, and antifungal treatments to control pathogens. Dosage, purpose of use, and method of application are as follows:

1) Antibiotic therapies: Prophylactic Erythromycin treatments are administered orally in Bio-Diet soft-moist feed obtained from Bio-Oregon to produce a dose of 100 mg/kg of body-weight for up to 28 d. When oral administration is not feasible, as with anadromous adults, an intraperitoneal injection of erythromycin is given to fish at a dose of 20 mg/kg of body weight. In addition, fingerlings are fed Oxytetracycline as needed to control outbreaks of pathogenic aeromonads, pseudomonads, and myxobacteria bacteria as needed.

2) Egg disinfection: Newly fertilized eggs are water hardened in 100 mg/L solution of Iodophor for 20 minutes to inactivate viral and bacterial pathogens on the egg surface and in the perivitelline space. In addition, eyed-eggs transferred to IDFG facilities are disinfected in a 100 mg/L Iodophor solution for 10 minutes.

Spawning adults are analyzed for common bacteria (bacterial kidney disease *Renibacterium salmoninarum,* bacterial gill disease *Flavobacterium branchiophilum,* coldwater disease *Flavobacterium psychrophilum,* and motile aeromonad septicemia *Aeromonas* spp.) and viral pathogens (infectious pancreatic necrosis virus and infectious hematopoietic necrosis virus). In addition to the above, anadromous adult sockeye salmon are screened for *Parvicapsula minibicornis* and for the causative agent of whirling disease *Myxobolus cerebralis,* furunculous *Aeromonas salmonicida,* and the North American strain of viral hemorrhagic septicemia. Tissue samples are collected from the kidney and spleen of each fish and ovarian

fluid samples are collected from each female and analyzed at the Eagle Fish Health Laboratory. Results of fish health analysis of spawners will be used by IDFG and the SBSTOC to determine disposition of eggs and subsequent juveniles.

Fish health is checked daily by observing feeding response, external condition, and behavior of fish in each tank as initial indicators of developing problems. In particular, fish culturists look for signs of lethargy, spiral swimming, side swimming, jumping, flashing, unusual respiratory activity, body surface abnormalities, and unusual coloration. Presence of any of these behaviors or conditions is immediately reported to the program fish pathologist.

The presence of moribund fish is immediately reported to the fish pathologist for blood and parasite sampling; the fish pathologist routinely monitors captive broodstock mortalities to try to determine cause of death. American Fisheries Society (AFS) "Bluebook" procedures are employed to isolate bacterial or viral pathogens and to identify parasite etiology (Thoesen 1994). Dead fish are routinely analyzed for common bacterial and viral pathogens (e.g., bacterial kidney disease, infectious hematopoietic necrosis virus, etc). Genetic samples are also collected from spawned carcasses to facilitate mitochondrial DNA and/or nuclear DNA evaluations for sockeye salmon broodstocks held in the program. When a treatable pathogen is either detected or suspected, the program fish pathologist prescribes appropriate prophylactic and therapeutic drugs to control the problem. Select carcasses may be appropriately preserved for pathology, genetic, and other analyses. After necropsy, carcasses that are not vital to further analysis are disposed of as per language contained in the ESA Section 10 permit for the program.

Eyed-Egg and Fish Transfers

Eggs are shipped at the eyed stage between NOAA and IDFG facilities using a commercial air service. Iodophor-disinfected (100 ppm) eggs are packed at a conservative density in perforated tubes, then capped and labeled. Tubes are wrapped with hatchery water-saturated cheesecloth and packed in small coolers. Ice chips are added to ensure proper temperature maintenance, and coolers are sealed with packing tape. Personnel from IDFG and NOAA are responsible for shuttling coolers to air terminals.

Fry may be transferred between IDFG and NOAA facilities. If fry transfers occur, a commercial air service is used as described above. Fish are transported in plastic fish transfer bags containing 10°C water. Oxygen is added to the bags before sealing. Bags are placed in coolers containing ice chips to ensure an appropriate temperature environment. Coolers are sealed with packing tape and accompanied by IDFG personnel on the aircraft.

Containers used to transport fish vary by task. In all cases, containers of the proper size and configuration are used. Appropriate temperature, oxygen, and chemical composition are maintained during the handling and transfer phases of transportation. Containers vary from five-gallon plastic buckets and coolers for short-term holding and inventory needs to barge-mounted holding tanks for mid-lake (pelagic) fish releases and net pen fish transfers. Truck-mounted tanks, used for long distance transfers, are available to the program with 250 gal (946 L), 1,000 gal (3,785 L), and 2,500 gal (9,463 L) capacities. Transport guidelines are in place not to exceed 0.75 lb/gal (89 g/L).

Eyed-Egg and Fish Supplementation

Sockeye salmon have been reintroduced to Sawtooth Valley waters as eyed-eggs, presmolts, smolts, and prespawn adults.

Eyed-eggs are distributed to egg boxes manufactured by IDFG personnel specifically for this program. Plastic light baffle grids and plastic mesh netting partition and prevent eggs from falling into the biofilter ring medium until after hatch. Plastic mesh netting surrounding egg boxes allows fish to volitionally emigrate following yolk absorption. Each egg box accommodates approximately 3,000 eggs. Following loading, egg boxes are lowered to the lake substrate in approximately 3 m of water over known or suspected areas of lakeshore spawning.

Sockeye salmon presmolts are distributed to Sawtooth Valley lakes in truck-mounted transportation tanks. Fish are transferred from truck-mounted tanks to 250 gal (946 L) barge-mounted tanks for pelagic releases and net pen introductions. Adequate water temperature tempering occurs before the release of fish.

Sockeye salmon smolts are distributed to Sawtooth Valley waters using truck-mounted transportation tanks. To date, sockeye salmon smolts have only been introduced to the outlet of Redfish Lake Creek downstream of the juvenile out-migrant weir and to the Salmon River downstream of the Sawtooth Fish Hatchery weir. Adequate water temperature tempering occurs before the release of fish.

Prespawn adult sockeye salmon are distributed to Sawtooth Valley waters using truck-mounted transportation tanks. Adults have been introduced to Redfish Lake, Alturas Lake, and Pettit Lake. Fish are released at public access points at dusk. Adequate water temperature tempering occurs before the release of fish.

RESULTS AND DISCUSSION

Fish Culture

During this reporting period, five broodstock and two production groups were in culture at IDFG facilities representing brood years 1999, 2000, 2001, 2002, and 2003. A summary of losses while in culture during this reporting period is presented in Tables 1 and 2. Culture groups developed to meet future spawning needs are designated as "broodstock" groups. Culture groups developed primarily for reintroduction to Sawtooth Valley waters are designated as "production" groups. The year of development for specific culture groups may appear abbreviated (e.g., BY96 refers to brood year 1996).

BY99 Broodstock

Eleven families, represented by 30 unique subfamilies, were developed from brood year 1999 broodstock spawn crosses at the Eagle Fish Hatchery. To simplify tracking, families were grouped under two broodstock group titles: BY99 and ANHBY99. The BY99 broodstock group was developed using male and female sockeye salmon from the ANBY96, BY96, and BY97 broodstocks (described above). Specific crosses performed to develop this broodstock group included: 1) ANBY96 females x BY97 males, 2) ANBY96 females x ANBY96 males, 3) ANBY96

females x BY96 males, 4) BY96 females x ANBY96 males, and 5) BY96 females x BY97 males. The ANHBY99 broodstock group was developed using male and female sockeye salmon from ANBY96, BY96, BY97 broodstocks and four of the seven anadromous adults that returned to the Sawtooth Fish Hatchery in 1999 (ANH99). Specific crosses performed to develop this broodstock group included: 1) ANBY96 females x ANH99 males, 2) BY96 females x ANH99 males, 3) ANH99 female x ANBY96 males, 4) ANH99 female x BY96 males, 5) ANH99 female x BY97 males, and 6) ANH99 female x cryopreserved milt from the single male sockeye salmon that returned to Redfish Lake Creek in 1998 (AN98). Initial inventory for this reporting period included eight fish. Seven BY99 males matured in 2003 and were utilized in spawn crosses. At the end of this reporting period, zero fish from BY99 broodstock remained in culture at the Eagle Fish Hatchery (Table 1).

BY00 Broodstock

Approximately 900 eyed-eggs were segregated from spawn crosses made in 2000 to create the BY00 broodstock representing ten families (54 unique subfamilies). Approximately 346 eyed-eggs and 42 fry were transferred to NOAA facilities where they will remain through maturation. The majority of BY00 broodstock adults produced at NOAA facilities will contribute to future spawning designs. Inventory reporting for these fish will appear under separate cover by NOAA. Initial inventory for the BY00 broodstock at Eagle Fish Hatchery was 339 fish. Three hundred twenty-five fish matured in 2003. Thirty-five mature sockeye (25 females and 10 males) were released to Redfish Lake on September 17, 2003. The remaining 290 mature sockeye (204 females and 86 males) were incorporated into the spawning design. One hundred ninety-six females and 80 males were utilized in hatchery spawn crosses. At the end of this reporting period, five BY00 broodstock remained in culture at the Eagle Fish Hatchery (Table 1).

BY01 Broodstock

Approximately 870 eyed-eggs were segregated from spawn crosses made in 2001 to create the BY01 broodstock representing 11 families (50 unique subfamilies). Approximately 435 eyed-eggs were transferred to NOAA facilities where they will remain through maturation. The majority of BY01 broodstock adults produced at NOAA facilities will contribute to future spawning designs. Inventory reporting for these fish will appear under separate cover by NOAA. Initial inventory for the BY01 broodstock at Eagle Fish Hatchery was 323 fish. Seventy-five fish matured at age-2 (11 females and 64 males) and were incorporated into the spawning design. Eleven females and 61 males were used in the spawning matrix during 2003. At the end of this reporting period, 235 BY01 broodstock fish were in culture (Table 1).

BY02 Production

Two hundred forty-seven spawn crosses representing 89 females and 115 males were developed from brood year 2002 production spawn crosses at the Eagle Fish Hatchery. The BY02 production group was developed using male sockeye salmon from the BY98, BY99, and BY00 broodstocks and female sockeye salmon from the BY99 and BY00 broodstocks (described above). Specific crosses performed to develop production groups included: 1) BY99 females x BY98 males, 2) BY99 females x BY99 males, 3) BY99 females x BY00 males, and 4) BY00 females x BY99 males. Approximately 65,838 eyed-eggs were produced from BY02 spawn crosses at Eagle Fish Hatchery. Eagle Fish Hatchery transferred 64,891 BY02

production eggs to the Sawtooth Fish Hatchery on November 27 and December 11, 2002. Approximately 29,592 eyed-eggs were transferred from the NOAA Burley Creek Hatchery to the Sawtooth Fish Hatchery on November 27 and December 4, 2002. Initial inventory at Sawtooth Hatchery was 94,483 fry. Presmolts were released into Redfish L (59,810), Pettit L (14,961), and Alturas L (2,017) on October 6 and 7, 2003. At the end of this reporting period, 199 fish from the BY02 production group remained in culture at Sawtooth Hatchery (Table 2).

BY02 Broodstock

Approximately 840 eyed-eggs were segregated from production groups described above to create the BY02 broodstock representing 79 unique females and 106 unique males. Cryopreserved milt from AN91 males was used to cross with BY99 females. Fourteen crosses were attempted with cryopreserved milt from three AN91 males; none of the crosses were successful in fertilization. Approximately 420 eyed-eggs were transferred to NOAA facilities on November 27 and December 11, 2002, where they will remain through maturation. The majority of BY02 broodstock adults produced at NOAA facilities will contribute to future spawning designs. Inventory reporting for these fish will appear under separate cover by NOAA. At the start of this reporting period, 420 developing fry were in culture at Eagle Fish Hatchery. At the end of this reporting period, 339 fish remained in culture at Eagle Hatchery (Table 1).

BY03 Production

Five hundred ninety-five spawn crosses representing 209 females and 148 males were developed from brood year 2003 production spawn crosses at the Eagle Fish Hatchery. The BY03 production group was developed using male sockeye salmon from the BY99, BY00, and BY01 broodstocks and female sockeye salmon from the ANHBY03, BY00, and BY01 broodstocks (described above). Specific crosses performed to develop production groups included: 1) ANHBY03 females x BY99 males, 2) ANHBY03 females x BY00 males, 3) BY00 females x BY99 males, 4) BY00 females x BY00 males, 5) BY00 females x BY01 males, 6)BY01 females x BY99 males, and 7)BY01 females x BY00 males. Approximately 303,983 eyed-eggs were produced from BY03 spawn crosses at Eagle Fish Hatchery. Eagle Fish Hatchery transferred 113,663 BY03 production eggs to the Sawtooth Fish Hatchery on November 19, 25, and December 3, 2003. Approximately 86,342 eyed-eggs were transferred from the NOAA Burley Creek Hatchery to the Sawtooth Fish Hatchery on November 19 and 25, 2003. Initial inventory at Sawtooth Hatchery was 200,005 eyed-eggs. Eyed-eggs were also produced for the egg box program in Pettit L (149,966) and Alturas L (49,700). Eagle Hatchery has 42,249 remaining on station for a fall pre-molt transfer to Oregon Department of Fish and Wildlife (ODFW) Oxbow Hatchery for a spring 2005 smolt program. Ending inventory for Sawtooth Hatchery was 197,965 fry, and Eagle Hatchery was 42,235 fry. An additional 502 eyed eggs were transferred to NOAA on November 25 and December 10, 2003 for an adult release program. Inventory reporting for these fish will appear under separate cover by NOAA (Table 2).

BY03 Broodstock

Approximately 837 eyed-eggs were segregated from production groups described above to create the BY03 broodstock representing 208 unique females and 146 unique males. No cryopreserved milt was used in the spawn design for 2003. Approximately 419 eyed-eggs were

transferred to NOAA facilities on November 25 and December 10, 2003, where they will remain through maturation. The majority of BY03 broodstock adults produced at NOAA facilities will contribute to future spawning designs. Inventory reporting for these fish will appear under separate cover by NOAA. At the start of this reporting period, 418 developing fry were in culture at Eagle Fish Hatchery. At the end of this reporting period, 418 fish were in culture at Eagle Hatchery (Table 1).

Anadromous and Residual Sockeye Salmon Trapping

Two adult traps capture returning anadromous sockeye salmon in the Sawtooth Valley. The first trap is located on Redfish Lake Creek approximately 1.4 km downstream from the lake outlet and was operated from July 10 to September 25 in 2003. The second trap is located on the upper Salmon River at the Sawtooth Fish Hatchery weir and was operated from June 12 to September 9 in 2003.

In 2003, three anadromous sockeye salmon returned to the Sawtooth Valley. Two fish were captured, one on August 1 and the second on August 18, in 2003. Both fish were trapped at the Redfish Lake Creek trap. Additionally, one adult sockeye salmon was observed immediately downstream of the Sawtooth Fish Hatchery trap but was not handled. Returning adult sockeye salmon with adipose fin clips originated from 2000 presmolt (BY99) releases in Redfish, Alturas, and Pettit lakes. A summary of adult returns is presented in Table 3.

No adult Chinook salmon *O. tshawytscha* were captured at the Redfish Lake Creek trap. However, one adult male Chinook was observed above the weir.

2003 Production Spawning

The IDFG is required by Permit No. 1120 to discuss proposed broodstock spawning matrices with NOAA Northwest Fisheries Science Center (NWFSC) genetics staff. In addition, the proposed broodstock spawning matrices were distributed and discussed at the SBSTOC held on September 11, 2003 in Stanley, Idaho (Appendix A). No objections to the proposed spawning design were aired.

During the fall of 2003, seven age-4 fish (all male) from the BY99 broodstock, 290 age-3 fish (204 females and 86 males) from the BY00 broodstock, and 75 age-2 fish (11 females and 64 males) from the BY01 broodstock matured at the Eagle Fish Hatchery. Genetic samples were collected and analyzed for the two anadromous adults (ANH03) trapped in 2003. Both returning adults were females, which were transferred to Eagle Hatchery and incorporated into the captive broodstock spawning design to ensure males would be available for spawn crosses.

Two hundred nine females and 148 males were spawned at Eagle Fish Hatchery between October 10 and November 13, 2003 to generate 341,921 green eggs. To avoid inbreeding, an effort was made to outcross fish from different brood years (e.g., BY00 females spawned with BY99 males). When this was not possible, within brood year spawn crosses were made based on a desirability matrix designed to avoid or minimize inbreeding.

Five hundred ninety-five unique subfamilies were developed from brood year 2003 production spawn crosses at the Eagle Fish Hatchery. To simplify tracking, families were grouped under one production group title, BY03. The BY03 production group was developed

using male and female sockeye salmon from BY99, BY00 and BY01 broodstock and male sockeye salmon from BY99, BY00 and BY01 broodstock. Specific crosses performed to develop this production group included: 1) ANH03 females x BY99 males, 2) ANH03 females x BY00 males, 3) ANH03 females x BY01 males, 4) BY00 females x BY99 males 5) BY00 females x BY00 males, 6) BY00 females x BY01 males, and 7) BY01 females x BY00 males. Spawn crosses produced approximately 341,921 green and 303,983 eyed-eggs. Brood year 2000 female fecundity averaged 1,656 eggs and BY01 female fecundity averaged 1,102 eggs. Egg survival to the eyed stage of development for the BY03 production group averaged 88.9% (median 95.0%) (Table 4).

In 2003, no spawn crosses were attempted with cryopreserved milt.

Results for brood year 2003 spawn crosses conducted by NOAA will be reported under separate cover by that agency.

2003 Broodstock Spawning

Approximately 418 eyed-eggs representing 208 unique females and 146 unique males were selected from specific spawn crosses described above and incubated for future broodstock needs. A duplicate component of 419 eyed-eggs was created at Eagle Fish Hatchery and transferred to the NOAA Burley Creek Hatchery to establish their 2003 broodstock group. Spawn crosses represented in the Eagle broodstock are presented in Table 5.

Milt Cryopreservation

No milt from maturing sockeye salmon was cryopreserved in 2003.

Fish Health Investigations

The IDFG Eagle Fish Health Laboratory processed samples for diagnostic and inspection purposes from broodstock and production groups of sockeye salmon, anadromous adult sockeye salmon that were retained for hatchery spawning, sockeye salmon smolts obtained from out-migrant traps, and *O. nerka* obtained from trawl efforts. Forty-seven laboratory cases involving 466 individual fish were processed in 2003. The laboratory also summarized pathology findings to satisfy the needs of adjacent state agencies for issuance of sockeye salmon import and transport permits.

There was no evidence of viral pathogens in any of the production and broodstock groups in 2003, which was consistent with results from previous years. In addition, no viral pathogens were detected in the two anadromous adult female sockeye salmon examined in 2003. Mortality caused by infectious hematopoietic necrosis virus (IHNV) was observed in BY00 spring Chinook salmon in February of 2002 at Sawtooth Fish Hatchery; however, IHNV was not detected in sockeye salmon reared during the same time period in a nearby outside raceway. To investigate the presence of IHNV in spawned-out carcasses of Chinook salmon above the river water supply of the Sawtooth Fish Hatchery, carcasses of Chinook salmon were sampled in 2003. Sixty-three carcasses were examined, and IHNV was not detected. This work was done to assist in a risk-analysis of rearing sockeye salmon in the Sawtooth Fish Hatchery river

water supply in the future. The Redfish Lake sockeye salmon population remains the only sockeye salmon population in the Pacific Northwest that does not have IHNV.

Clinical bacterial kidney disease (BKD), caused by *Renibacterium salmoninarum,* did not occur in any production groups of sockeye salmon juveniles reared at Eagle or Sawtooth Fish Hatchery in 2003. Captive adult sockeye salmon spawned in 2003 were free of clinical levels of BKD; however, the enzyme-linked immunosorbent assay (ELISA) optical density (OD) levels of two spawned captive sockeye salmon minimally exceeded the IDFG-established background OD level of 0.10 (0.113, 0.124). *Renibacterium salmoninarum (Rs)* antigen was not detected in either of the anadromous adult sockeye salmon examined in 2003. Additionally, *Rs* antigen was not detected in smolts collected during emigration from Redfish or Pettit Lake out-migrant trapping locations. Out-migrants from Alturas Lake were not collected for fish health sampling in 2003 due to the low number of smolts trapped at the Alturas Lake Creek out-migrant.

Furunculosis, caused by *Aeromonas salmonicida,* was detected in one of the two anadromous adult sockeye salmon post-spawning. The presence of *A. salmonicida* indicates the need for Oxytetracycline and Erythromycin injections shortly after adults are trapped.

The myxosporean parasite, *Myxobolus cerebralis,* which can cause salmonid whirling disease, is present in the upper Salmon River. *Oncorhynchus nerka* samples obtained by trawling in Redfish, Pettit, and Alturas lakes are examined annually for *M. cerebralis.* Alturas Lake samples were found to be positive for *M. cerebralis* (3 of 5 fish sampled) in 2003 using polymerase chain reaction (PCR) testing. In addition, a neurotropic *Myxobolus* species was detected (PCR testing) in both of the anadromous adult sockeye salmon that returned to Redfish Lake Creek in 2003. The Eagle Fish Health Laboratory continues to investigate infectivity of *M. cerebralis* in the river water supply of the Sawtooth Fish Hatchery using sentinel rainbow trout fry. Results are used to assess the risk of rearing sockeye salmon on river water during the winter months.

A myxosporean parasite, *Parvicapsula minibicornis,* was detected in both anadromous adult sockeye salmon in 2003. Detection of *P. minibicornis* was made by PCR at the lab of Dr. Simon Jones, Department of Fisheries and Oceans, Canada; however, histological confirmation was not obtained, which indicates that the infections were light. These results are similar to those obtained by Dr. Jones for sockeye salmon of the Fraser River in British Columbia, Canada. *Parvicapsula minibicornis* has been demonstrated to be contracted in the estuary before sockeye enter the Columbia River mainstem.

In 2003, the two anadromous adult sockeye salmon were examined for the presence of *Piscirickettsia salmonis* and *Ceratomyxa shasta.* The results were negative for both pathogens, indicating that *P. salmonis* and *C. shasta* have not become established in the upper Salmon River.

Eyed Egg and Fish Transfers

In all cases, the required State transfer permits were acquired before shipping. Specific details, by date, for all transfers are described below.

On November 25 and December 10, 2003, approximately 419 eyed-eggs for NOAA captive broodstock program and 502 eyed-eggs for NOAA adult release program from Eagle Hatchery broodstock crosses were transferred from the Eagle Fish Hatchery to the NOAA

Burley Creek Fish Hatchery. Fish that mature as a result of this transfer will be incorporated in future NOAA spawning designs or released as adults into Redfish Lake.

On November 19 and 25 and December 3, 2003, approximately 113,663 eyed-eggs from production crosses were transferred from the Eagle Fish Hatchery to the Sawtooth Fish Hatchery. On November 19 and 25, 2003, approximately 86,342 eyed-eggs were transferred from the NOAA Burley Creek Hatchery to the Sawtooth Fish Hatchery. Fish that result from these transfers will be used to fill fall 2004 presmolt release strategies and spring 2005 smolt release strategies.

Eyed Egg and Fish Reintroductions

Pursuant to Special Condition B9 Requirement D3 of Permit No. 1120, IDFG received authorization from NOAA to carry out the following production releases of sockeye salmon in 2003 (Table 6). All sockeye salmon released were adipose fin clipped.

Adult Releases

Maturing adult sockeye salmon were released to Redfish Lake in September 2003 for volitional spawning. On September 15 and 16, 48 and 232 (respectively) NOAA Manchester Marine Laboratory hatchery-reared BY00 adults (mean weight 1,530.0 grams) were released. Additionally, 35 IDFG Eagle Fish Hatchery-reared BY00 adults (mean weight 1,500.0 grams) were released September 17, 2003. Efforts were made to release fish of equal sex ratios. Due to a lack of sexual dimorphism in NOAA-reared fish, sex ratios could not be positively determined in all fish.

Presmolt Releases

Presmolt releases to Sawtooth Valley lakes were conducted in October 2003 at midlake (pelagic) locations with the aid of a release barge on loan to IDFG from NOAA. All presmolts were from brood year 2002 and were reared at IDFG's Sawtooth Fish Hatchery. Presmolts from Sawtooth Fish Hatchery were adipose fin-clipped prior to release, with a representative number of fish PIT tagged for evaluation purposes. On October 6, Pettit Lake received 14,961 presmolts reared at the Sawtooth Fish Hatchery. Fish from this group were adipose fin clipped (2,014 PIT tags) and had a mean weight of 10.7 grams per fish. On October 6, Alturas Lake received 2,017 (100% PIT tagged) ad-clipped presmolts (mean weight 8.0 grams per fish). On October 6 and 7, 2003, Redfish Lake received 59,810 ad-clipped presmolts (mean weight 11.0 grams per fish, 1,519 PIT tagged).

Eyed-egg Planting

On November 25 and December 3 and 10, 2003, approximately 149,966 eyed-eggs were transferred to eyed-egg boxes and released into Pettit Lake (11,662 from NOAA Burley Creek Hatchery and 138,304 eyed-eggs from Eagle Fish Hatchery). On December 11, 2003, approximately 49,700 eyed-eggs were transferred to eyed-egg boxes and released into Alturas Lake (41,272 eyed-eggs from NOAA Burley Creek Hatchery and 8,428 eyed-eggs from IDFG Eagle Hatchery).

Table 1. Summary of losses and magnitude of mortality for five captive sockeye salmon broodstocks reared at IDFG facilities in 2003.

	Culture Groups				
	BY99	**BY00**	**BY01**	**BY02**	**BY03**
Starting Inventory (January 1, 2003)	8	339[a]	323	420	837[b]
Eyed-ego to Fry					
Undetermined[c]	na	na	na	68	na
Mechanical Loss					
Handling	0	0	0	0	na
Jump-out	0	0	0	0	na
Transportation	0	0	0	0	na
Noninfectious					
Lymphosarcoma	0	0	0	0	na
Nephroblastoma	0	0	0	0	na
Other[d]	1	9	13	13	na
Infectious					
Bacterial	0	0	0	0	na
Viral	0	0	0	0	na
Other	0	0	0	0	na
Maturation Spawners					
Mature Males	7	80	61	0	na
Mature Females	0	196	11	0	na
Maturation Non-Spawners					
Mature Males	0	6	3	0	na
Mature Females	0	8	0	0	na
Relocation					
Transferred In	0	0	0	0	na
Transferred Out	0	0	0	0	419[e]
Planted/Released	0	35	0	0	na
Ending Inventory (December 31, 2003)	0	5	235	339	418

[a] Starting inventory reflects an inventory adjustment made post-completion of the 2002 BPA Annual Report.

[b] December 2003 developing fry and egg numbers.

[c] Typical egg to fry mortality includes non-hatching eggs, abnormal fry, and swim-up loss.

[d] Includes culling associated with cultural abnormalities and all undetermined, noninfectious mortality.

[e] Transferred from IDFG Eagle Fish Hatchery to NOAA for broodstock rearing.

Table 2. Summary of losses and magnitude of mortality for two captive sockeye salmon production groups reared at IDFG facilities in 2003.

	Culture Groups			
	BY02 Sawtooth	**BY03 Sawtooth**	**BY03 Eagle**	**BY03 NOAA**
Starting Inventory (January 1, 2003)	94,483[a]	200,005[b]	42,249[b]	502
Eyed-egg to Fry				
Undetermined[c]	14,994	2,040	14	na
Mechanical Loss				
Handling	0	na	na	na
Jump-out	0	na	na	na
Transportation	0	na	na	na
Noninfectious				
Lymphosarcoma	0	na	na	na
Nephroblastoma	0	na	na	na
Other[d]	2,502	na	na	na
Infectious				
Bacterial	0	na	na	na
Viral	0	na	na	na
Other	0	na	na	na
Maturation				
Mature Males	0	na	na	na
Mature Females	0	na	na	na
Other	0	na	na	na
Relocation				
Transferred In	0	86,342[e]	na	na
Transferred Out	0	0	na	502
Planted/Released	76,788	na	na	na
Ending Inventory (December 31, 2003)	199	197,965	42,235	0

[a] December 2002 developing fry and egg numbers (combined NOAA and Eagle numbers).
[b] December 2003 developing fry and egg numbers (combined NOAA and Eagle numbers).
[c] Typical egg to fry mortality includes non-hatching eggs, abnormal fry, and swim-up loss.
[d] Includes culling associated with cultural abnormalities and all undetermined, noninfectious mortality.
[e] Transferred from NOAA to IDFG Sawtooth Fish Hatchery for production rearing.
[f] Includes 113,891 and 86,342 eyed-eggs from Eagle and NOAA facilities, respectively.
[g] Transferred to NOAA Burley Creek Hatchery for Adult Release Program.

Table 3. Year 2003 anadromous sockeye salmon adult return summary.

Summary Category	Total Number Trapped	Number Trapped at Redfish Lake Cr.	Number Trapped at Sawtooth Hatchery
All Anadromous Adults	2	2	0
Anadromous Males	0	0	0
Anadromous Females	2	2	0
Unmarked Adults[a]	0	0	0
Adipose-Clipped Adults[b]	2	2	0

[a] Unmarked adults are presumably the result of eyed-egg and prespawn adult release strategies conducted in Redfish Lake in 1999. Unmarked adults could also be progeny of Redfish Lake residual sockeye salmon. Age data for these adults is not complete; confirmation of origin is pending.

[b] Adipose-clipped adults are presumably from a 2000 fall presmolt release from fish reared at Sawtooth Fish Hatchery. Age data for these adults is not complete; confirmation of origin is pending.

Table 4. Summary information for 2003 sockeye salmon spawning activities at Eagle Fish Hatchery.

Spawning Cross*		No. of Green Eggs Taken	No. of Eyed-Eggs	Mean Egg Survival to Eyed-Stage	Median Egg Survival to Eyed-Stage
Female	Male				
ANH03	BY99	770	760	98.70%	98.70%
ANH03	BY00	2,563	2,504	97.70%	97.48%
ANH03	BY01	1,822	1,778	97.59%	97.33%
BY00	BY99	29,465	26,082	88.52%	94.82%
BY00	BY00	192,136	170,839	88.92%	95.13%
BY00	BY01	103,044	90,460	87.79%	93.45%
BY01	BY00	12,121	11,560	95.37%	97.65%
TOTALS		341,921	303,983	88.90%	95.02%

Note:* ANHO3 refers to anadromous adults returning in 2003.
BY99 refers to captive adults produced in spawn year 1999.
BY00 refers to captive adults produced in spawn year 2000.
BY01 refers to captive adults produced in spawn year 2001.

Table 5. Parent family and number of eyed-eggs retained for brood year 2003 captive broodstock development at Eagle Fish Hatchery.

Family Cross*		No. of Eyed-eggs Retained for Eagle Broodstock
Female	**Male**	
ANHO3	BY99	1
ANHO3	BY00	4
ANHO3	BY01	3
BY00	BY99	25
BY00	BY00	218
BY00	BY01	145
BY01	BY00	22
	TOTAL	418

Note:* ANHO3 refers to anadromous adults returning in spawn year 2003.
BY99 refers to captive adults produced in spawn year 1999.
BY00 refers to captive adults produced in spawn year 2000.
BY01 refers to captive adults produced in spawn year 2001.

Table 6. Sockeye salmon releases made to Sawtooth Valley waters in 2003. Note: Ad = adipose fin clip.

Release Location	Strategy (Brood Year)	Release Date	Number Released	Number PIT Tagged	Marks	Release Weight (g)	Rearing Location
Alturas Lake (direct lake)	presmolt (2002)	10/06/03	2,017	2,017	Ad	8.0	IDFG Sawtooth Fish Hatchery
Pettit Lake (direct lake)	presmolt (2002)	10/06/03	14,961	2,014	Ad	10.7	IDFG Sawtooth Fish Hatchery
Redfish Lake (direct lake)	presmolt (2002)	10/06/03	59,810	1,519	Ad	11.0	IDFG Sawtooth Fish Hatchery
Redfish Lake	adult (2000)	9/15/03	48	—	None	1,200.0	NOAA Burley Creek Hatchery
	(2000)	9/16/03	135	—	None	1,745.0	NOAA Burley Creek Hatchery
	(2000)	9/16/03	97	—	None	1,395.0	NOAA Manchester Marine Lab
	(2000)	9/17/03	35	—	None	1,500.0	IDFG Eagle Fish Hatchery
Pettit Lake	eyed-egg (2003)	11/25/03	11,662	—	—	—	NOAA Burley Creek Hatchery
	(2003)	11/25/03	70,795	—	—	—	IDFG Eagle Fish Hatchery
	(2003)	12/03/03	45,451	—	—	—	IDFG Eagle Fish Hatchery
	(2003)	12/10/03	22,058	—	—	—	IDFG Eagle Fish Hatchery
Alturas Lake	eyed-eggs (2003)	12/11/03	41,272	—	—	—	NOAA Burley Creek Hatchery
	(2003)	12/11/03	8,428	—	—	—	IDFG Eagle Fish Hatchery

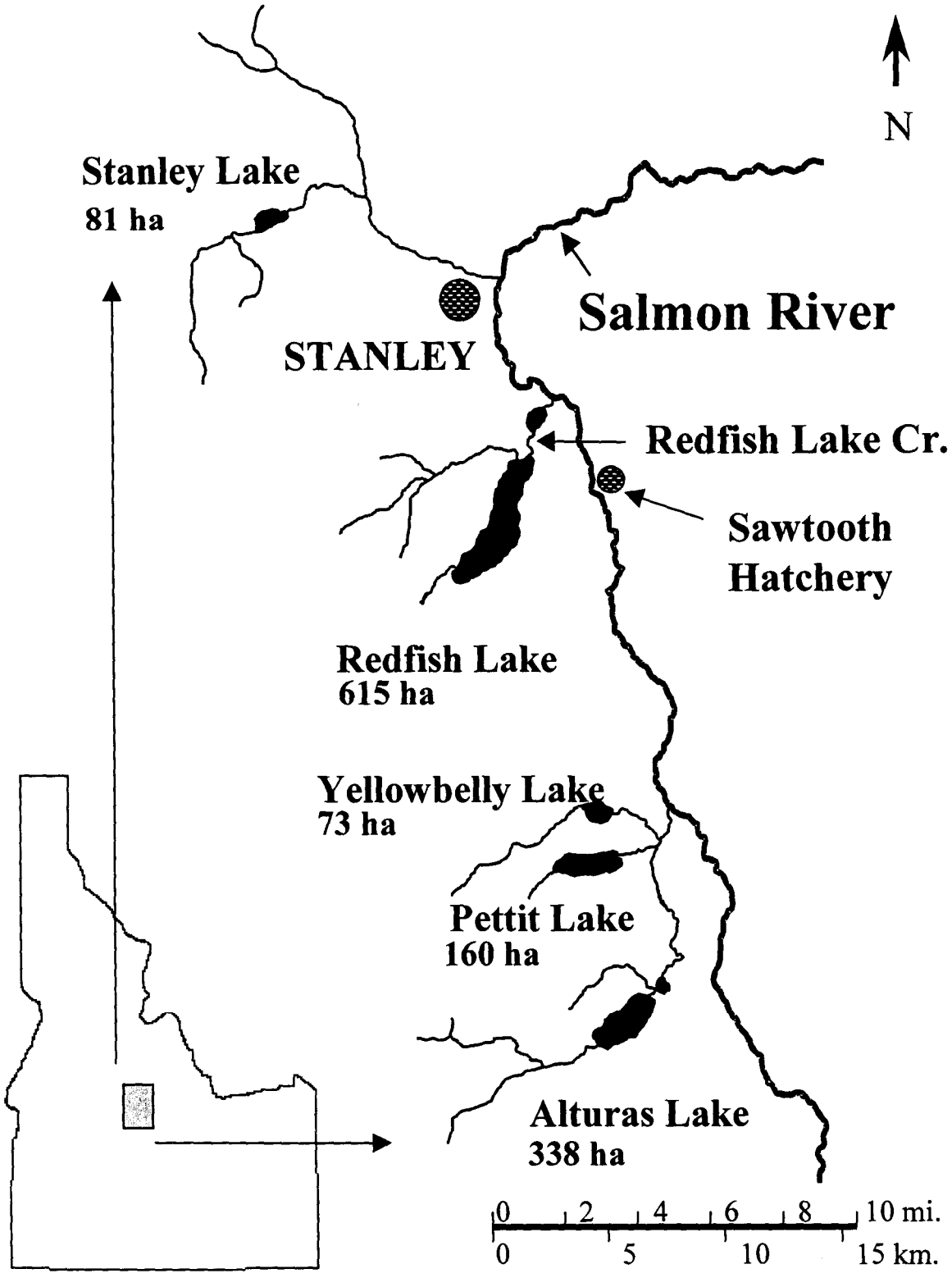

Figure 1. Sawtooth Valley study area.

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APPENDICES

Appendix A. Year 2003 spawning matrix memo.

IDAHO DEPARTMENT OF FISH AND GAME
EAGLE FISH HATCHERY
1800 Trout Road, Eagle ID 83616
phone (208) 939-4114, fax (208) 939 2415

September 5, 2003

MEMORANDUM

To: **SBSTOC**

From: **Paul Kline, Dan Baker, Carlin McAuley, Jeff Heindel, Catherine Willard**

Subject: **2003 Sockeye Salmon Spawning Matrix**

At IDFG and NOAA facilities in 2003, the primary rearing group to reach maturity will be age-3 fish produced in brood year 2000. In addition, a small number of age-4 BY99 males and a yet to be determined number of age-2 BY01 males are expected to mature.

Following examination of broodstocks by ultrasound at Eagle Fish Hatchery on 8/8/03 and NOAA Burley Creek Hatchery on 6/26/03, the following numbers of maturing and immature fish are in culture:

Eagle BY99	**NOAA BY99**
Maturing females = 0	Maturing females = 0
Maturing males = 7	Maturing males = 2
Immature fish = 0	Immature fish = 1

Eagle BY00	**NOAA BY00**
Maturing females = 228	Maturing females = 193
Maturing males = 96	Maturing males = 100
Maturing unk. = 0	Maturing unk. = 2
Immature fish = 4	Immature fish = 12

Eagle BY01	**NOAA BY01**
Maturing females = not yet determined	Maturing females = unknown
Maturing males = not yet determined	Maturing males = Approx. 20

BY99 LINEAGES:

Fifteen specific family groups (lineages) were initially developed in 1999; 11 family groups were selected to create the BY99 broodstock. Seven of the 15 groups were developed from the three hatchery-produced, anadromous, age-3 "jacks and jill" (ANH99) that were incorporated in the spawning design. Age-3 anadromous returns were produced from program production crosses in BY96. Two mitochondrial DNA haplotypes are represented (H9 and H25). Anadromous fish were crossed within group and out-crossed with BY96 and BY97 broodstock fish. The eight remaining major broodstock subfamilies produced in 1999 were between BY96 and BY97 broodstock adults.

Brood year 1996 production fish were generated primarily from first generation progeny of the eight wild, anadromous adults that returned in 1993. Brood year 1996 broodstock fish were produced from the single wild, anadromous female that returned in 1996; first generation progeny of the eight wild, anadromous adults that returned in 1993; and 1991 and 1993 wild, Redfish Lake out-migrants. Brood year 1997 broodstock fish were produced from the single wild, anadromous female that returned in 1994 and first generation progeny of the four wild, anadromous adults that returned in 1991. In addition, cryopreserved milt from 1991 and 1992 out-migrants was used.

Note: The majority of adults from this broodstock spawned in 2002. Four of the original 15 lineages are represented in the seven males still on station at the Eagle Fish Hatchery.

BY00 Lineages:

The majority of fish from this group represent a variety of spawn crosses and are related to the hatchery-produced anadromous adults that returned in 2000, and the wild, anadromous adults that returned in 1992, 1993, 1994, 1996, and 1998. Wild, Redfish Lake out-migrants from 1991, 1992, and 1993 are also represented in this broodstock.

Sixteen families, represented by 49 unique sub-families, were developed from brood year 2000 spawn crosses at the Eagle Fish Hatchery; 10 family groups were selected to create the BY00 broodstock. To simplify tracking, families were grouped under two production group titles: BY00 and ANHBY00. The BY00 group was developed using male and female sockeye salmon from the BY97 and BY98 broodstocks. Specific crosses performed to develop this production group included: 1) BY97 females x BY97 males, 2) BY97 females x BY98 males and 3) BY98 females x BY97 males. The ANHBY00 production group was developed using male and female sockeye salmon from BY97 and BY98 broodstocks and 38 (18 females and 20 males) of the 41 anadromous adults that returned to the Sawtooth Valley in 2000 and were retained for spawning. Specific crosses performed to develop this production group included: 1) ANH00 females x BY97 males, 2) ANH00 females x BY98 males, 3) ANH00 females x ANH00 males and 4) BY97 females x ANH00 males.

BY01 Lineages:

Sixteen families, represented by 86 unique sub-families, were developed from brood year 2001 spawn crosses at the Eagle Fish Hatchery; eleven family groups were selected to from the BY01 broodstock. To simplify tracking, families were grouped under two production group titles: BY01 and ANHBY01. The BY01 production group was developed using male and female sockeye salmon from the BY98 and BY99 broodstocks. Specific crosses performed to develop this production group included: 1) BY98 females x BY99 males and 2) BY98 females x BY98 males. The ANHBY01 production group was developed using male and female sockeye salmon from the BY98 broodstock, male sockeye salmon from the BY99 broodstock and 9 (2 females and 7 males) of the 26 anadromous adults that returned to the Sawtooth Valley in 2001 and were retained for spawning. Specific crosses performed to develop this production group included: 1) ANH01 females x BY98 males, 2) ANH01 females x BY99 males, and 3) BY98 females x ANH01 males.

2003 Anadromous Returns:

At the time of this writing, two sockeye salmon (one male and one female) have been captured at Sawtooth Valley trapping locations (both on Redfish Lake Creek). While specific lineages will be difficult to identity, mtDNA and nDNA markers will be used to genotype both adults. At this time, it is our recommendation that both adults be retained and incorporated in the hatchery spawning design at the Eagle Fish Hatchery.

Proposed Spawning Design:

The following spawning design was developed to guide both IDFG and NOAA staff with year 2003 spawning activities. The plan takes into account pedigree information for captive fish and genetic marker information for hatchery-produced anadromous adults and has been designed to minimize the risks associated with inbreeding. Note: at the time of this writing, genetic information for anadromous returns was still pending.

Spawn preference matrices have been developed for crosses between BY00 females X BY00 males, BY00 females X BY99 males, and BY00 females X BY01 males. Again, the primary cross type that will be made in 2003 will be BY00 females X BY00 males.

Each of the three cross preference sheets (attached) contains two tables. All tables list males along the left margin and females across the top. The first table of each sheet identifies the number of lineage groups originally produced for each broodstock (e.g., L1 through L10 for the BY00 broodstock, L1 through L15 for the BY99 broodstock, and L1 through L11 for the BY01 broodstock). The percentages identified in each cell of the first table reflect pedigree overlap (with respect to wild, founding contributors) for each specific cross. For example: a value of 50% indicates that male and female spawners share 50% of the original broodstock founders (e.g., wild anadromous, out-migrant, and residual fish) in their immediate pedigrees. Similarly, 50% of the original founders used to develop these two lineages do not overlap.

Note: Original founder groups and their representation in the BY00 broodstock at the grandparent through great-great grandparent level are presented in a table following the three spawn preference matrices. The letters A through W have been used to represent the 23 original, wild contributors to the captive population.

The second table of each cross preference sheet identifies the number of individual fish (by lineage) in the IDFG component of the program expected to mature in 2003. In addition, the designations: 1st, 2nd, and 3rd are used to identify the proposed hierarchy of spawn preferences for this year. First-tier crosses represent 50% or less pedigree overlap between males and females. Second-tier and third tier crosses represent 51% to 70% and 71% to 100% overlap, respectively.

To incorporate all individuals in the spawning design, 1st and 2nd tier crosses will be emphasized in 2003. This is especially true for crosses performed between BY00 males and BY00 females. Crosses performed between BY99 males and BY00 females as well as between BY01 males and BY00 females will have more latitude to emphasize the 1st tier level. Third tier crosses will be minimized but performed if specific individuals are at risk of not being represented in the spawning design. By avoiding "same lineage" crosses (e.g., L1 x L1 etc.), potential sibling crosses will be avoided.

Prepared by:

Dan J. Baker
Hatchery Manager II

Jeff A. Heindel
Assistant Hatchery Manager

Jeremy J. Redding
Fish Culturist

Paul A. Kline
Principal Fisheries Research Biologist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Virgil K. Moore, Chief
Bureau of Fisheries

Tom Rogers
Anadromous Fish Hatcheries Supervisor